Hybrid Landfill Gas Systems
Breakout Session Summary Report

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Natural Gas /Renewable Energy

Hybrids Workshop

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Facilitator's Observations

- **Good spread of participants in session**
- **What's a Hybrid?**
  - Definition and boundaries
- **New mindset**
- **Significant interest**

Agenda

- Introductions
- Definition of Terms?
- Processes
- Questions to be addressed

Configurations of Landfill Gas Energy Systems

- **Single power producing unit using fuel blending - Natural Gas (NG) and Landfill Gas (LFG) (9 votes)**
- **Conversion of LFG to LNG, CNG or methanol, which can be stored and or shipped (6 votes)**
- **Multiple power producing units with dedicated fuel - NG and LFG (5 votes)**

Single power producing unit using fuel blending - NG and LFG

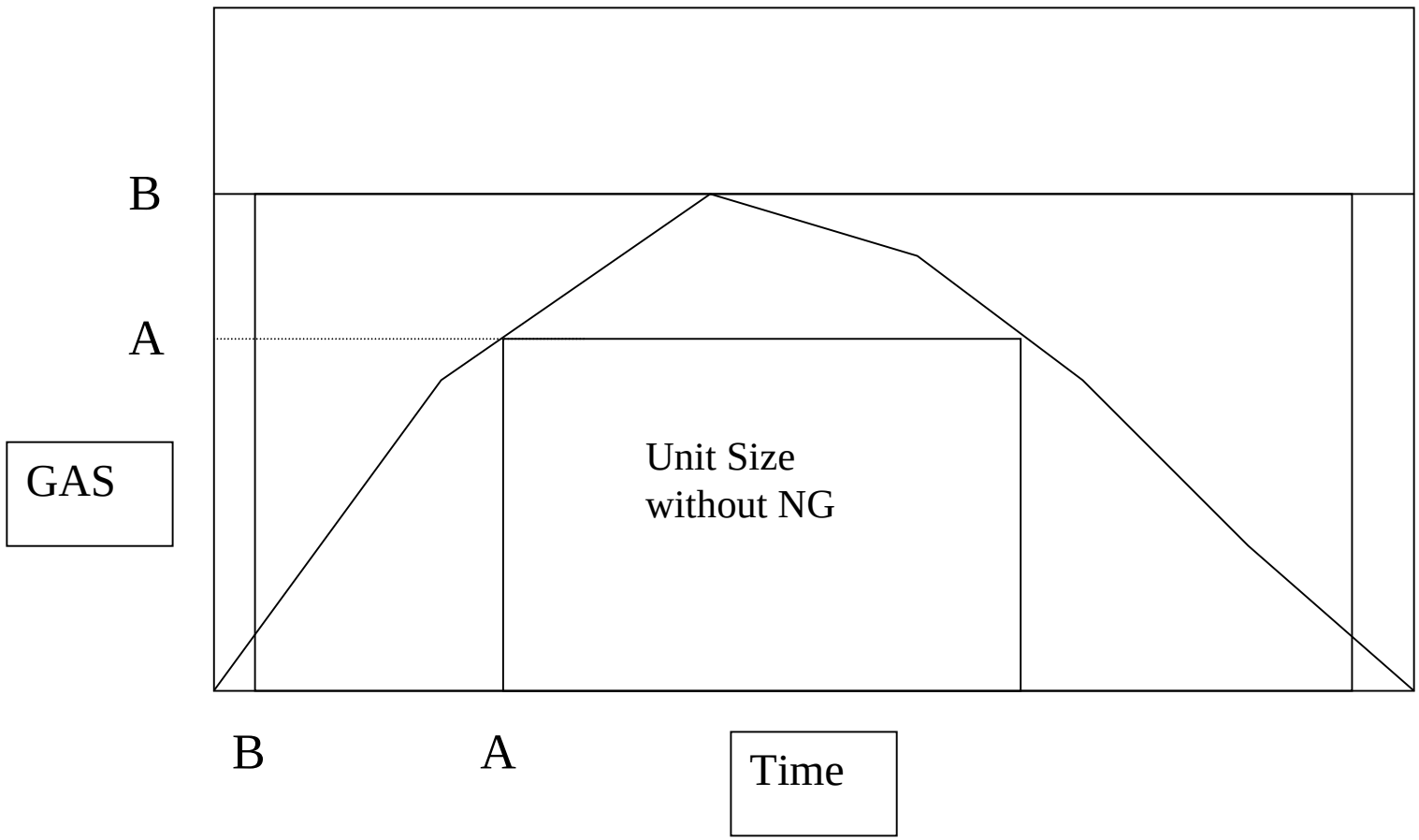
Advantages

- Addresses LFG waste issue
- Multiple fuel sources increases reliability
- Low risk, near term technology
- Increase and stabilize output
- Allows for fuel cost benefit optimization

Disadvantages / Barriers

- Must be near to natural gas line
- Regulatory constraints - QF as defined in PURPA
- Must match with load or
- Access to electrical distribution system or end-user
- Volatility of NG price
- High tech knowledge required (operation)
- NOx emissions will go up compared to 100% LFG

LFG waste issue



Conversion of LFG to LNG, CNG or methanol, which can be stored and or shipped

Advantages

- Allows energy to be stored
- Transportable
- Increases value of fuel
- Expands application options for the fuel
- Can lower fuel costs for waste disposal fleet
- CO2 available as second product

Disadvantages / Barriers

- LNG trucks are not as efficient compared to diesel
- Must clean up conversion by products
- Must meet capital cost of equipment hurdle
  - 10,000 gallon LNG/day plant

Multiple power producing units with dedicated fuel - NG and LFG

Advantages

- Potential for high efficiency
- With devices dedicated to either fuel, permitting will be easier
- Maximized LFG fuel usage
- Better load following capability
- Cans use SCR technology in NG engine to reduce NOx
- Do no have to do fuel blending
- System would have high versatility for other uses
- Potential to improve site economics
- Combine LFG base load unit and NG peaking unit in one plant
- Less complex than fuel blending

Multiple power producing units with dedicated fuel - NG and LFG

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R&D Required to Overcome Barriers

- **R&D that Crosscuts Configurations**
  - Limited database of information on applying the technologies in the defined configurations (High)
  - Configurations require first of a kind demonstrations to secure user acceptance (High)
  - Interconnection with electric utility (Medium)
  - Define status of carbon credits (Medium)
  - R&D to verify regulatory constraints (Low)
  - Ways to control generation rates of LFG (Low)
  - Standardization of equipment components (Low)

R&D Required to Overcome Barriers

- **Non-Crosscutting R&D**
  - Engine efficiency using LNG (High)
  - Blending carburetor equipment (Medium)
  - Lower cost, lower size liquefaction plant (Medium)
  - Research additional applications of conversion byproducts (Low)